

Claims

- [c1] A method of forming a trench capacitor in a substrate comprising the steps of:
etching a trench having substantially vertical sidewalls;
depositing a thermally stable filler material in the trench;
annealing the filler material in an oxidizing ambient;
recessing the filler material down to a capacitor top level;
forming insulating spacers on the trench sidewalls above the capacitor top level;
stripping the filler material;
doping the trench sidewalls below the spacers; and
depositing a conductive electrode within the trench.
- [c2] A method according to claim 1 in which the thermally stable filler material is deposited in direct contact with the sidewalls.
- [c3] A method according to claim 1, in which the step of annealing the filler material is performed at a temperature of less than 500C; and the step of forming the spacers is performed by atomic layer deposition.
- [c4] A method according to claim 3, in which the step of heating the filler material is performed in-situ on a spin-

on track during the step of trench filling.

- [c5] A method according to claim 1, in which the step of forming the spacers is performed by depositing high-k material.
- [c6] A method according to claim 2, in which the step of forming the spacers is performed by depositing high-k material.
- [c7] A method according to claim 3, in which the step of forming the spacers is performed by depositing high-k material.
- [c8] A method according to claim 5, in which the step of forming the spacers is performed by depositing a material selected from the group comprising Al₂O₃, HfO₂, ZrO₂ and La₂O₃ and their silicates.
- [c9] A method according to claim 6, in which the step of forming the spacers is performed by depositing a material selected from the group comprising Al₂O₃, HfO₂, ZrO₂ and La₂O₃ and their silicates.
- [c10] A method according to claim 7, in which the step of forming the spacers is performed by depositing a material selected from the group comprising Al₂O₃, HfO₂, ZrO₂ and La₂O₃ and their silicates.

- [c11] A method according to claim 1, in which a step of performing a bottle etch precedes the step of depositing a thermally stable filling material.
- [c12] A method according to claim 1, in which the step of heating the filler material is performed at a temperature of less than 800C and the step of forming the spacers is performed by low pressure deposition of nitride or oxide at a temperature of less than 800C.
- [c13] A method according to claim 12, in which a step of performing a bottle etch precedes the step of depositing a thermally stable filling material.
- [c14] A method of forming an integrated circuit containing a DRAM array comprising the steps of:
 - a) forming a capacitor by:
etching a trench having substantially vertical sidewalls;
depositing a thermally stable filler material in the trenches;
heating the filler material in an oxidizing ambient;
recessing the filler material down to a capacitor top level;
forming spacers on the trench sidewalls;
stripping the filler material;
doping the trench sidewalls below the spacers; and
depositing a conductive electrode within the trench;

b) forming a transistor connecting a bitline to the conductive electrode; and
completing the integrated circuit.

- [c15] A method according to claim 14, in which the thermally stable filler material is deposited in direct contact with the sidewalls.
- [c16] A method according to claim 14, in which the step of annealing the filler material is performed at a temperature of less than 500C; and the step of forming the spacers is performed by atomic layer deposition.
- [c17] A method according to claim 16, in which the step of heating the filler material is performed in-situ on a spin-on track during the step of trench filling.
- [c18] A method according to claim 16, in which the step of forming the spacers is performed by depositing high-k material.
- [c19] A method according to claim 17, in which the step of forming the spacers is performed by depositing high-k material.
- [c20] A method according to claim 19, in which the step of forming the spacers is performed by depositing a material selected from the group comprising Al₂O₃, HfO₂,

ZrO₂ and La₂O₃ and their silicates.